Introduction

Chapter Overview

Many recommendations for strengthening higher education in science and engineering that were made a half-century ago in Science and Public Policy[2] are still being implemented or are still of national concern (Steelman 1947). These recommendations of the President's Scientific Research Board—referred to herein as the Steelman report—included expanding institutions of higher education, training scientists and engineers in all fields of knowledge, and providing U.S. leadership in disseminating scientific knowledge. This chapter suggests that several of these recommendations have been accomplished, as the trends regarding expansion of and greater access to higher education and the leadership role of U.S. universities in training scientists and engineers from around the world demonstrate. This chapter also addresses other recommendations that are still topics of concern, such as improving the teaching and research experience of undergraduates, educating adequate numbers of students willing and able to pursue advanced S&E programs, and creating the "right" number of S&E doctorates to meet the needs of the workplace. In addition, this chapter presents indicators on current concerns that are different from those of the past—especially the participation of women and minorities in S&E, the dependence on foreign students in U.S. graduate S&E programs, and the stay rates and return patterns of foreign doctoral recipients.

Chapter Organization

This chapter begins with a review of the growth of U.S. higher education from the early 1950s; this review presents the characteristics of the diverse set of institutions that fostered this growth. The chapter notes the prominence of research universities in the expansion of S&E degrees, as well as the continuing importance of comprehensive and liberal arts colleges. The review highlights increased access to higher education provided by community colleges.

The main body of the chapter presents trends in enrollment and degrees in broad fields of S&E at various levels—associate's, bachelor's, master's, and doctorate. The characteristics of U.S. freshmen show their intentions to major in S&E as well as some lack of readiness for college-level work. Following the review of bachelor-level trends, international data are presented to compare participation rates across several world regions. In addition, international comparisons are made at the doctoral level, and information is presented on the worldwide movement toward expansion and reform of graduate S&E education. Further international comparisons are made with regard to the participation of women in S&E fields at the bachelor's and doctoral levels and the proportion of doctoral degrees earned by foreign students.

The final sections of the chapter address patterns of diversity in U.S. higher education. The increasing representation of women and minorities in S&E degrees is shown over time and by field. Long-term trends of increasing foreign student enrollment and degrees, as well as recent downturns in these trends, are discussed.

Other chapters of this volume cover related topics in S&E education. Chapter 3, "Science and Engineering Workforce," discusses the entry of S&E graduates at various levels into the U.S. labor force in S&E occupations and the contribution of foreign doctoral recipients who remain in the United States for teaching and research. Chapter 6, "Academic Research and Development," includes indicators of graduate student financing, faculty composition, and the link between R&D funding and graduate enrollment; the bibliometric section of that chapter also provides initial indicators of the growing percentage of the world's scientific literature from countries expanding their graduate education in S&E. Chapter 7, "Industry, Technology, and the Global Marketplace," provides initial indicators of competitiveness—high technology trade and patenting—of countries that have expanded their doctoral S&E training and are building their science infrastructure. Chapter 9, "Significance of Information Technologies," includes the impact of technology on higher education.

Characteristics of U.S. Higher Education Institutions

The defining characteristics of U.S. higher education that foster access—a broad array of institutional types and sizes, public and private funding, and flexible attendance patterns—were already in place in the early 1950s. In 1953, more than 1,870 institutions—including universities; liberal arts colleges; teachers' colleges; and technological, theological, and other professional schools—were providing higher education. These diverse institutions included public and private colleges and universities and provided for part-time attendance. One-fifth of the undergraduate students were enrolled part-time (U.S. HEW 1956). Students were concentrated in universities and liberal arts colleges; only 13 percent were enrolled in junior colleges. (See text table 4-1.)

Expansion of Institutions

These underlying characteristics of U.S. higher education have persisted during the past 50 years, with expansion occurring through the establishment of many new institutions and the increasing size of universities. In 1953, the largest universities enrolled approximately 10,000 students. By 1996, the largest U.S. universities enrolled between 25,000 and 50,000 students (HEP 1996). Enrollment has surged within research and comprehensive universities. A number of teachers' colleges expanded their offerings and became comprehensive and doctoral institutions. While the number of universities has doubled since the 1950s, the number of two-

[2]See chapter 1.